

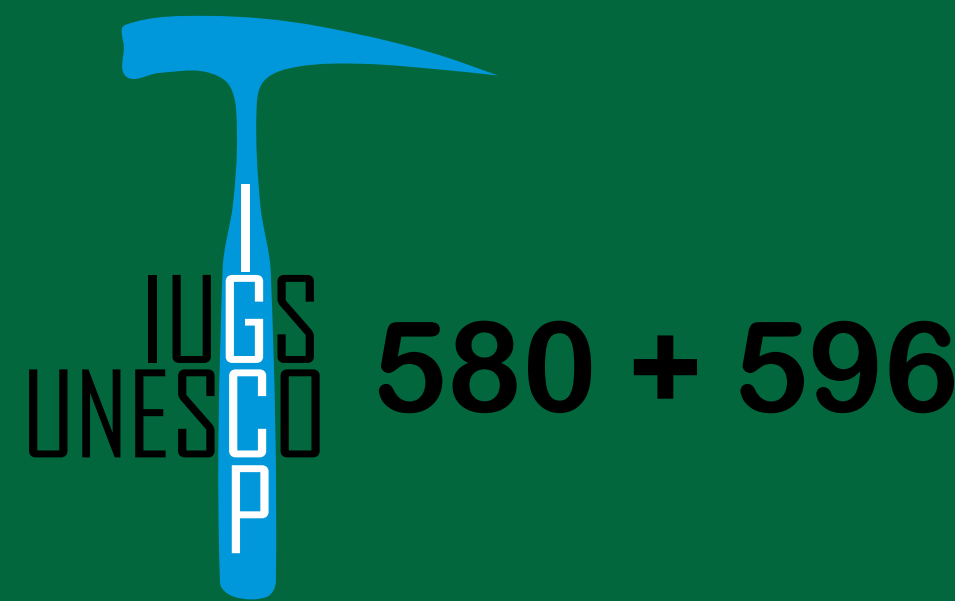
Insights into a million-year-scale Rhenohercynian carbonate platform evolution through a multi-disciplinary approach: example of a Givetian carbonate record from Belgium

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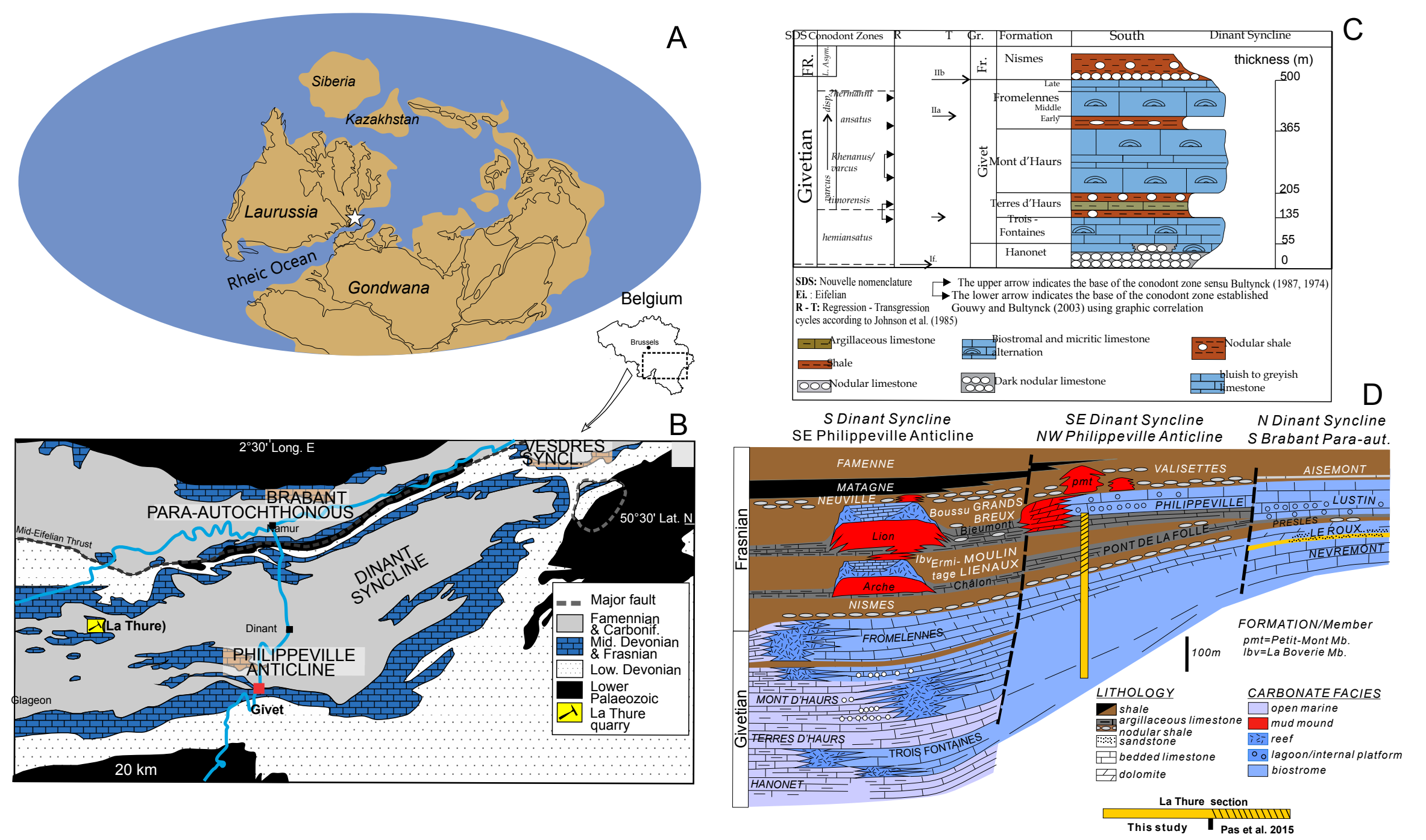
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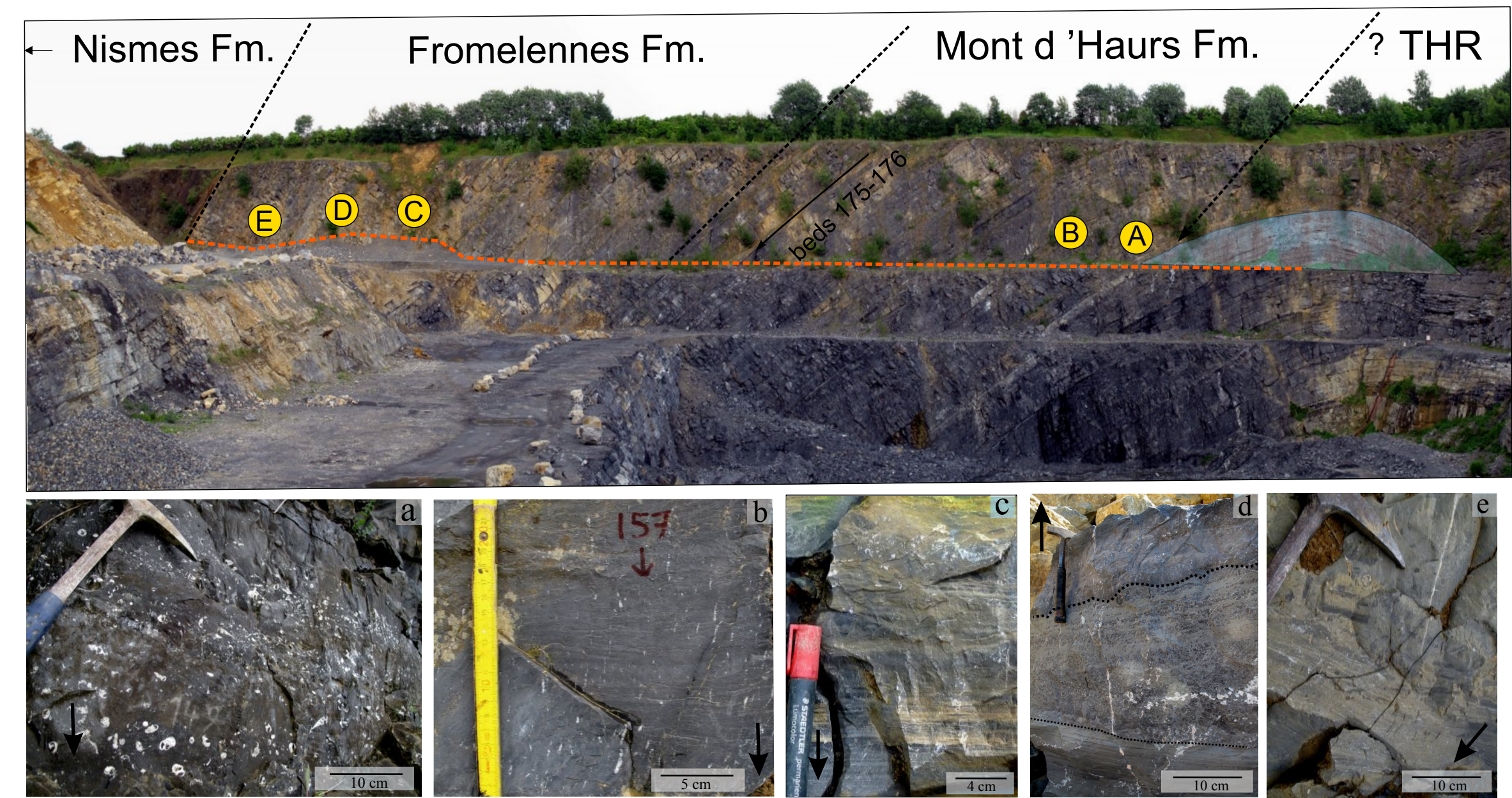


1. Givetian in Belgium and France

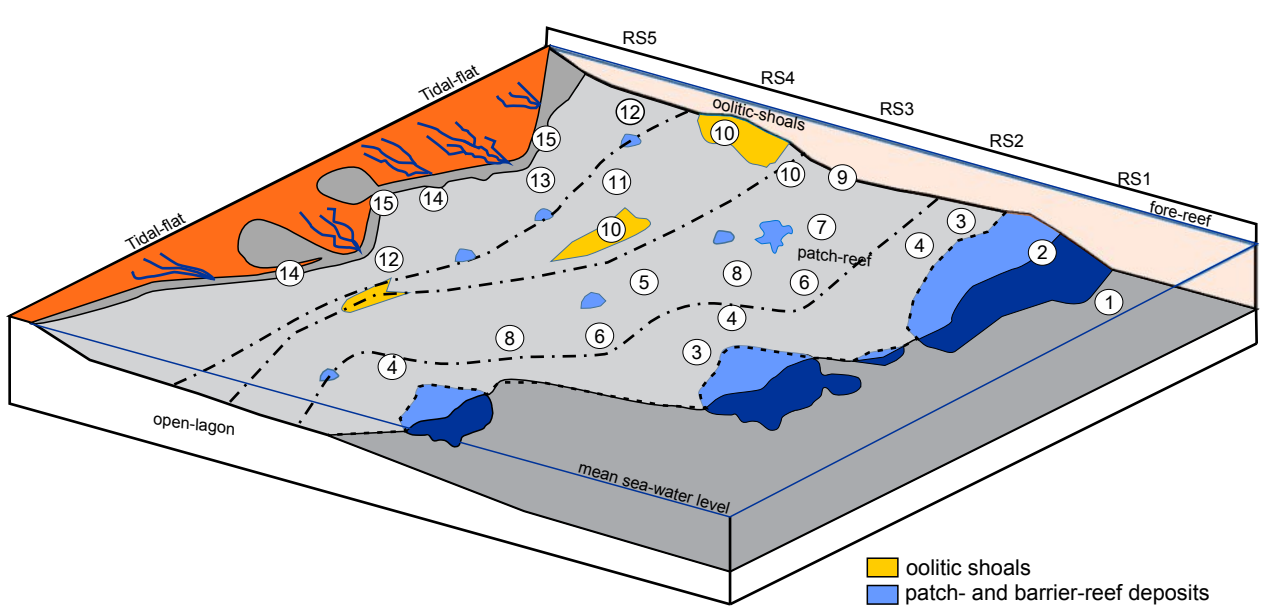
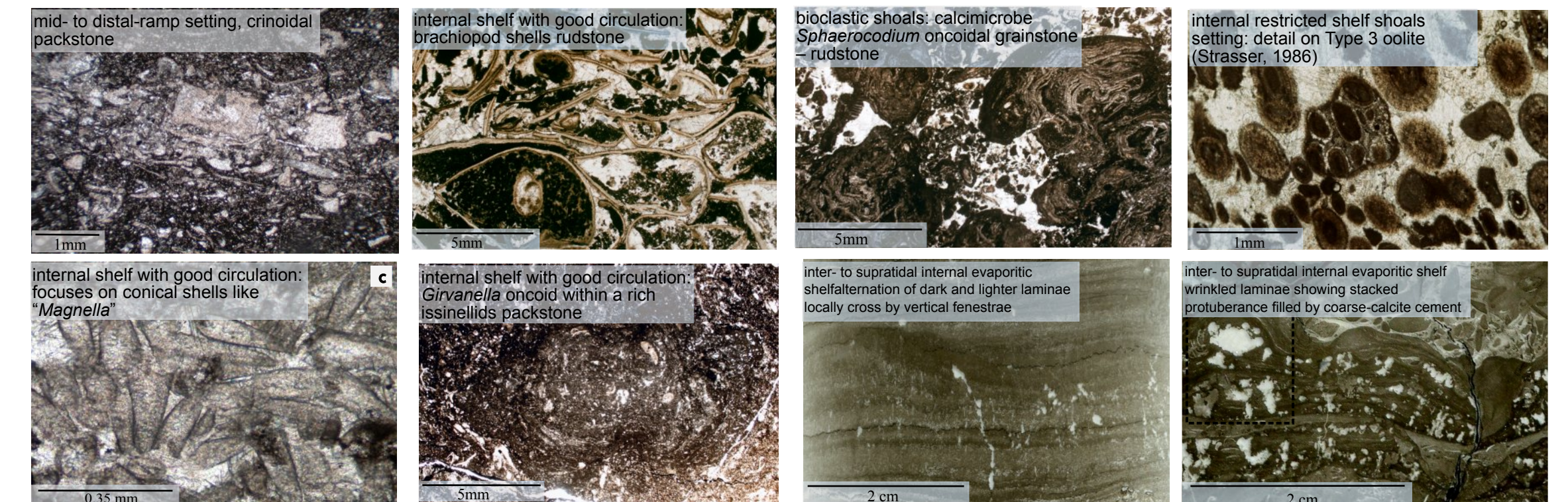


a Location of Belgium in the eastern margin of Laurussia during the Devonian (Kiesling et al. 2003). b Simplified geological map of southern Belgium. c Givetian lithostratigraphic column established for the southern border of the Dinant Syncline showing conodont zones (Bultynck, 1974; Bultynck, 1987; Gouvy and Bultynck, 2003) and the main transgressive – regressive cycles (Johnson et al., 1985). d Integrated lithostratigraphical and palaeogeographical framework for the Givetian and Frasnian of Belgium. Relative position of the reefs shows the retrogradation-progradation patterns of the carbonate platforms (modified after Boulvain et al., 2009)

2. La Thure section, facies & microfacies



a-e Close up on different facies, the black arrows point to the stratigraphic base. a Gastropod rich levels in the lower portion of the Mont d'Hours Formation. b Laminated limestone, showing vertical burrows filled by calcite exposed within the lower portion of the Unit 1, Mont d'Hours Fm. c Slightly yellowish laminated limestone commonly occurring within the Unit 2, Fromelennes Fm. d Thin-thick level (delimited by dashed lines) enriched in branching stromatopora (note that the lower boundary of this level is characterized by an erosion surface while the upper boundary is overlain by a thin laminated fabric) - erratic block near upper portion of the section corresponding to the Fromelennes Fm. e Intraformational breccia overlying a level of laminated limestone



- The La Thure section exposes a very well-preserved early to late-Givetian shallow-water carbonate record from the Rhenohercynian Ocean.
- An exceptional depositional diversity has been defined within the 152 m-thick succession. With a total number of 18 microfacies.

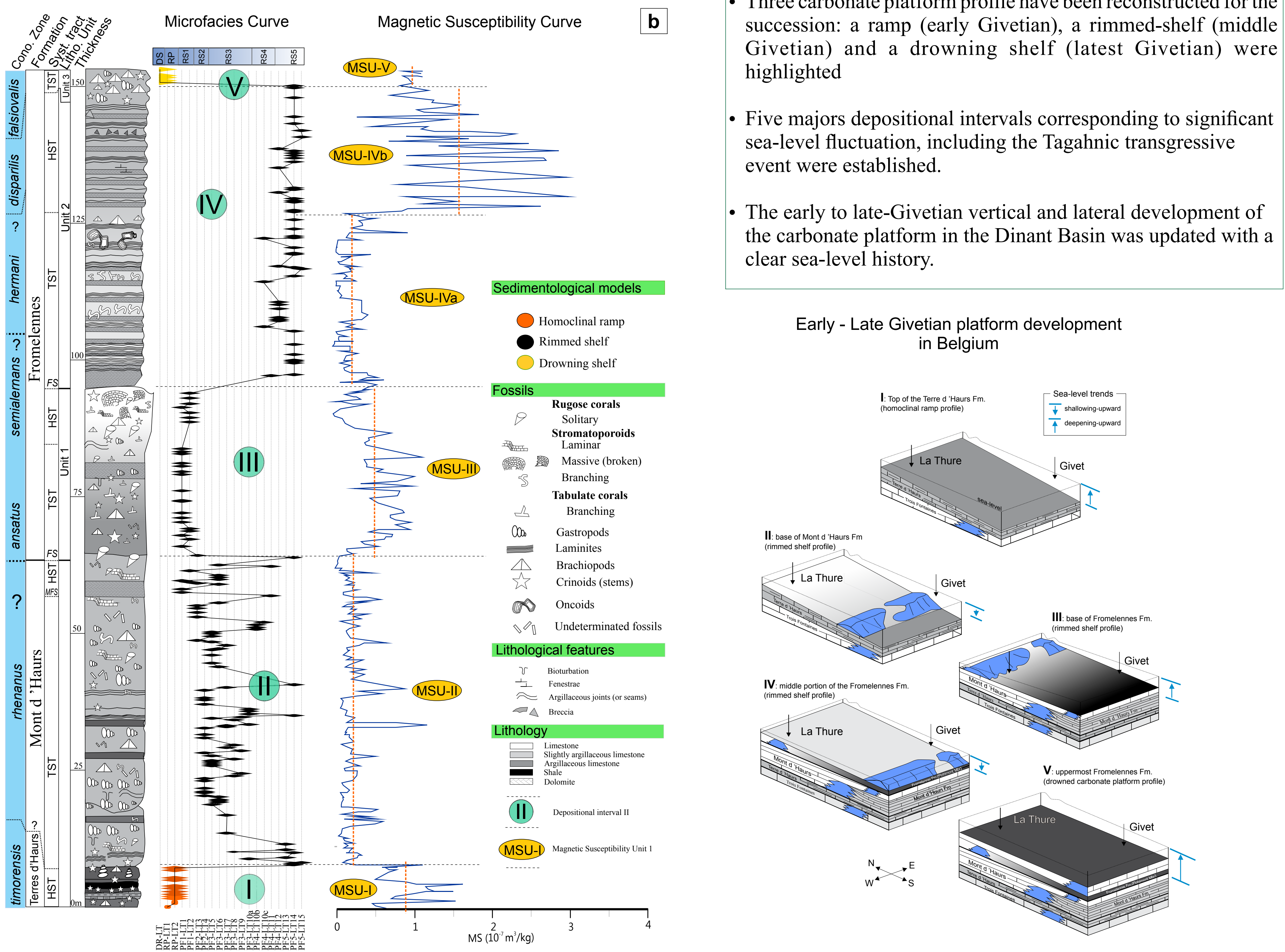
Abstract

Background: In this research we formulate answers to three important questions related to Givetian carbonate records and their use for reconstructing million-year-scale past palaeoenvironmental changes. First, we provide detailed illustrations of the fascinating diversity that shaped a significant shallow reefal platform during early to late Givetian time in the Rhenohercynian Ocean; secondly we improve the sedimentological model of the extensive Givetian carbonate platform in the Dinant Basin; and thirdly we evaluate the application of magnetic susceptibility as a tool for long-term trend correlations and palaeoenvironmental reconstructions.

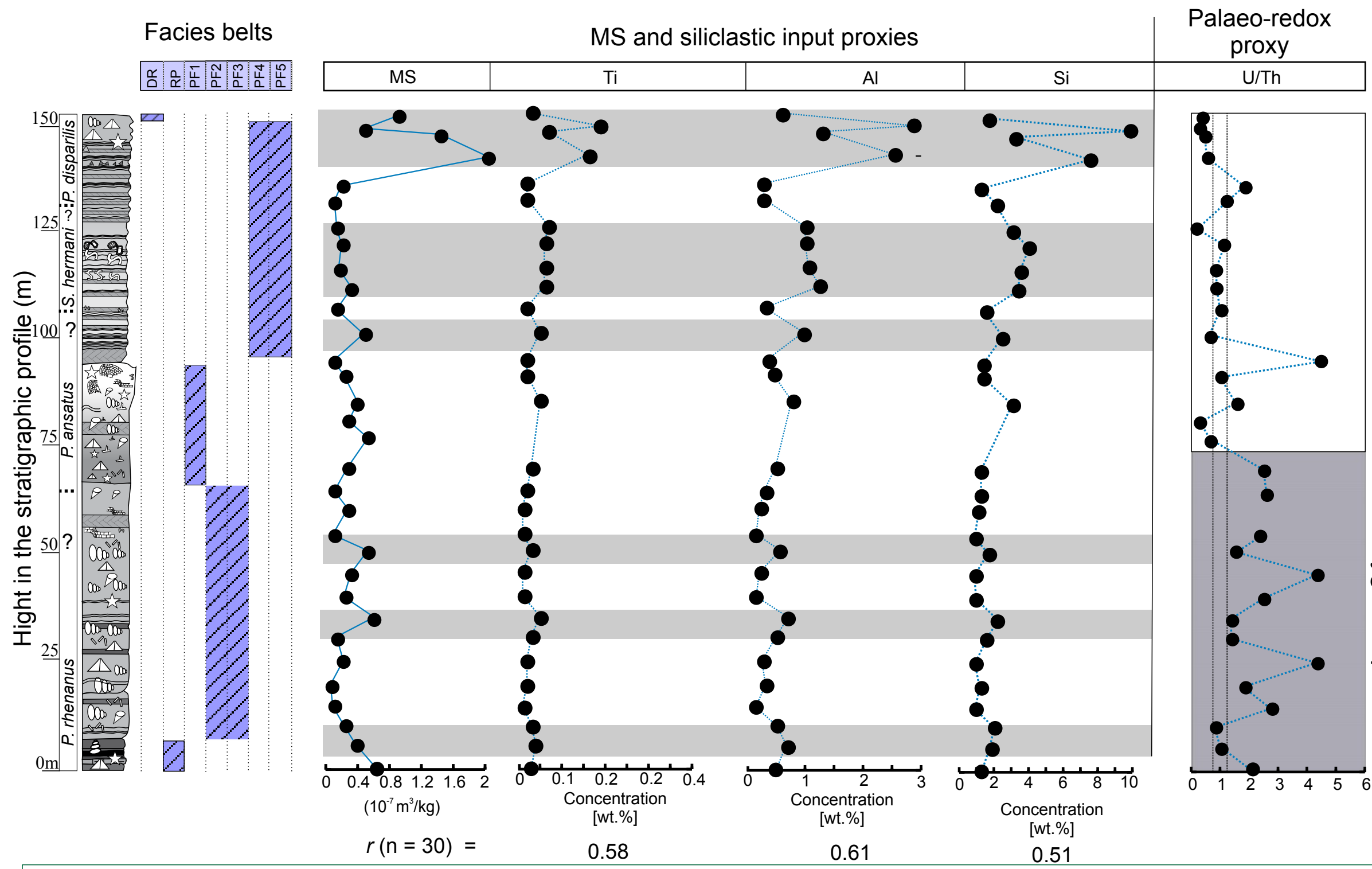
Methodology/Principal findings: These goals are reached by making a sedimentological, geophysical and geochemical study of the La Thure section. Through the early–late Givetian interval we discerned 18 microfacies ranging from a homoclinal ramp to a discontinuously rimmed shelf and then a drowning shelf. The comparison of these sedimentological results with those published for the south of the Dinant Syncline allowed us to provide an up to date model of the vertical and lateral environmental development of one of the largest Givetian carbonate platforms in Europe. This comparison also increased the knowledge on the distribution of facies belts in the Dinant Basin and allowed us to highlight the Taghanic Event. Palaeoredox proxies reveal a substantial change in the oxygenation level, from oxygen-depleted to more oxic conditions, between middle and late Givetian time. We demonstrated the relationship between variation in magnetic susceptibility values and proxies for siliciclastic input (such as Si, Al).

Significance: The La Thure section is considered a key section for the understanding of Givetian palaeoenvironmental changes within the internal shelf settings bordering Laurussia’s southeastern margin.

3. Million-year-scale palaeoenvironmental changes in the Dinant Basin



4. Magnetic susceptibility & geochemical evolution



Magnetic susceptibility (MS):

- Detrital components such as Ti, Si and Al show a moderate correlation with MS trends of the sample suite ($r=0.51-0.61$; $n=30$).
- Observed correlations indicate that the MS signal varies with the concentration in siliciclastic elements within the sediment. This means that variations in the terrestrial basinwards influx have a strong influence on the intensity of the MS signal.
- The good correlation between Ti and Al also mean that Al concentration related to diagenetic process is unlikely despite the remagnetization characterizing the Ardennes region (Zegers et al. 2003).
- In the La Thure section the MS techniques can be used as a proxy for changes in terrestrial influx driven either by variation of weathering type, reworked source or intensity of this reworking.

Redox proxies:

- calculated U/Th ratio for the La Thure section reveals a significant large-scale change in the oxygenation level of sediments (Fig. 18) from oxygen-depleted conditions throughout the lower half of the section to more oxic condition within upper half.
- In La Thure, the relationship between the depositional setting and the low U/Th ratio value presumably indicates an aridification of the climate as the driving process for the change in bottom water oxygenation (this is concurrent with data from the literature (Joachimski et al. 2004)).
- The paleo-temperature increases near the end of the mid Givetian is likely related to the Taghanic Event.

5. Acknowledgments and references

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